

Type D personality is associated with delaying patients to medical assessment and poor quality of life among rectal cancer survivors

Jia-kui Zhang¹ · Li-li Fang² · De-wei Zhang¹ · Qiu Jin³ · Xiao-mei Wu⁴ · Ji-chao Liu¹ · Chun-dong Zhang¹ · Dong-qiu Dai¹

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Abstract

Objective The aim of this research was to explore quality of life (QoL), mental health status, type D personality, symptom duration, and emergency admissions of Chinese rectal cancer patients as well as the relationship between these factors.

Methods Type D personality was measured with the 14-item Type D Personality Scale (DS14). Mental health status was measured with the Hospital Anxiety and Depression Scale (HADS). The QoL outcomes were assessed longitudinally using the European Organization for Research and Treatment of Cancer QLQ-C30 and QLQ-CR38 questionnaires at the baseline and 6 months after diagnosis.

Results Of the 852 survivors who responded (94 %), 187 (22 %) had a type D personality. The proportion of patients with duration of symptoms >1 month and being diagnosed after emergency admissions in type D group is significantly higher than that in non-type D group. At both of the time points, type D patients reported statistically significant lower scores on most of the functional scales, global health status/QoL scales, and worse symptom scores compared to patients without a type D

personality. At the 6-month time point, a higher percentage of patients in the type D group demonstrated QoL deterioration. Clinically elevated levels of anxiety and depression were more prevalent in type D than in non-type D survivors.

Conclusions Type D personality was associated with poor QoL and mental health status among survivors of rectal cancer, even after adjustment for confounding background variables. Type D personality might be a general vulnerability factor to screen for subgroups at risk for longer symptom duration and emergency admissions in clinical practice.

Keywords Rectal cancer · Type D personality · Referrals · Health-related quality of life · Health status

Introduction

Colorectal cancer is one of the top three leading causes of cancer-related deaths worldwide with an estimated 1.2 million new cancer cases and over 630,000 cancers deaths per year, almost 8 % of all cancer deaths [1]. The incidence rate of CRC in China was 20.90/100,000, and the mortality of CRC in China was 10.05/100,000 [2]. Because of improvements in treatment, such as total mesorectal excision and neoadjuvant (chemo) radiotherapy, the growing numbers of survivors have to live with the long-term consequences of rectal cancer and its treatment [3, 4]. Therefore, in addition to traditional study endpoints such as postoperative recovery, morbidity and survival, good quality of life (QoL), and mental health status have increasingly become major issues [5–7].

A distressed personality (type D) is defined by the combination of two personality traits: the tendency to experience negative emotions (negative affectivity) and to inhibit self-expression in social interaction (social inhibition) [8]. People that score high on negative affectivity have the tendency to

✉ Dong-qiu Dai
daidq1963@sina.com

¹ Department of Gastroenterological Surgery and Cancer Center, The Fourth Affiliated Hospital of China Medical University, 4 Chongshan Road, Shenyang 110032, P. R. China

² Department of Anesthesiology, The Second Affiliated Hospital Zhejiang University School of Medicine, Hangzhou 310009, People's Republic of China

³ Department of Psychiatry, The Fourth Affiliated Hospital of China Medical University, Shenyang 110032, People's Republic of China

⁴ Department of Clinical Epidemiology and Center of Evidence Based Medicine, The First Hospital of China Medical University, Shenyang 110001, People's Republic of China

experience negative emotions, while people that score high on social inhibition have the tendency not to express these emotions, because of fear of rejection or disapproval by others. Hence, individuals with a type D personality are inclined to experience emotional and interpersonal difficulties across time and situations.

In the cardiovascular field, the type D is an important research topic in recent years. Type D is recognized as an important determinant for adverse health outcomes, impaired health status and health-related quality of life (HRQoL), and several forms of distress (including anxiety, depression, and posttraumatic stress) in patients with cardiovascular diseases [9, 10]. Similar results have been found in patients with a range of other diseases as well [11, 12]. However, studies on type D personality among cancer survivors are scarce [13].

The Emergency Department (ED) plays a pivotal role in the evaluation of patients with RC. Many studies report worse QoL and outcome for patients with RC who present to the ED, both during their initial hospital stay and for their long-term survival [14–16]. In previous study, we also observed that ED referral patients endured significantly longer symptom duration before diagnosis [17, 18]. Patients with rectal cancers should contact the general practitioner or specialist in case symptoms arise. This places the responsibility of making an appointment with the patient, not the general practitioner or specialist, and therefore leaves more room for someone's personality to interfere with his or her symptom duration. A study among heart failure patients found that type Ds experienced more cardiac symptoms but less often reported these symptoms to their cardiologist compared to non-type Ds [10]. Therefore, we hypothesize that rectal cancer patients with a type D personality have a longer symptom duration before diagnosis because of the negative emotions and inhibition of self-expression in social interaction. Furthermore, we hypothesize that those with a type D personality have a lower QoL and mental health status than the non-type Ds.

We therefore conducted this prospective study to compare QoL outcomes and mental health status in Chinese rectal cancer patients with a type D personality vs patients with a non-type D personality. Changes in QoL over time were also longitudinally assessed and compared between the two groups. A secondary objective was to compare the symptom duration and proportion of emergency admissions in Chinese patients with a type D personality vs patients with a non-type D personality and to explore factors related to impaired QoL and mental health status.

Methods

Setting and participants

This study was performed at a tertiary-level teaching hospital of China Medical University with a total of 4000-beds and an

annual ED volume of 180,000 patients in Shenyang, China. Between July 2009 and July 2011, eligible Chinese patients with rectal cancer admitted to the hospital from the ED or referred from non-ED sources were enrolled in this prospective study. The study was conducted with the permission of the Ethics Committee of China Medical University (Shenyang, China). Written informed consent was obtained from each patient. Surveys were constructed and revised through multiple focus groups with medical specialists in oncology, psychology, and surgery. We excluded the following patients: participants older than 90 years of age at the time of survey were excluded, as it was expected that they would have difficulty in completing a self-administered questionnaire without assistance. Patients who had cognitive impairment, had died prior to start of the second survey, or had unverifiable addresses were excluded. Patients with the incomplete consent forms or missing identification were excluded.

Data collection

All questionnaires were administered by a single research assistant and completed by the patients at the time of diagnosis (after the first treatment) and at 6 months after diagnosis (during clinic visits). All patients were followed up regularly at 1-month intervals for clinical examination and carcinoembryonic antigen testing. If the patients did not visit the outpatients at 6 months after diagnosis, the research assistant sent the patients a letter to inform them about the study and a copy of the questionnaire by preaddressed, prestamped envelopes. Nonrespondents were sent a reminder letter and questionnaire within 1 month.

Measures

Sociodemographic and clinical information

Age, sex, symptoms before diagnosis, duration of symptoms before seeking medical advice, performance status, initial staging, postoperative complications, location of tumor, and laboratory tests including initial hemoglobin level, preoperative carcinoembryonic antigen (CEA), and CA19-9 levels were retrieved from the medical records. Our patient questionnaire also included questions on sociodemographic data, including marital status, current occupation, lifestyles, medical insurance status, educational level, and current comorbidity.

Type D personality

Type D personality was measured with the 14-item Type D Personality Scale [8] (DS14). The 14 items of this scale are answered on a 5-point response scale ranging from 0 (false) to 4 (true). Seven of these items refer to “negative affectivity” or the tendency to experience negative emotions in general. The

remaining 7 items refer to the patient's level of "social inhibition" or the tendency to inhibit the expression of emotions in social relationships. Patients were categorized as type D using a standardized cutoff score of ≥ 10 on both the negative affectivity and social inhibition subscales, following the protocol as previously established [8]. The scale of Chinese revision was completed through collaboration of Holland Tilburg University, Chinese University of Hong Kong and institute of psychology Chinese Academy of Sciences. The clinical validity and reliability of the Chinese translations of DS14 questionnaire have been confirmed in Chinese population. The DS14 is a valid and reliable scale with Cronbach's α of 0.88/0.86 and a test-retest reliability over a 3-month period of $r=0.72/0.82$ for the two subscales, respectively [8].

Quality of life assessment

Patient QoL was assessed using the QLQ-C30 and QLQ-CR38 questionnaires developed by the EORTC [19–21]. The clinical validity and reliability of the Chinese versions of both QLQ-C30 and QLQ-CR38 have been confirmed [22, 23]. QLQ-C30 is a generic questionnaire for the assessment of QoL in cancer patients [20]. It includes 30 items, 24 of which are combined to form a global QoL scale, five functional scales (physical, role, emotional, cognitive, and social), and three symptom scales (fatigue, nausea/vomiting, and pain). The other six single items evaluate dyspnea, insomnia, appetite loss, constipation, diarrhea, and financial difficulties. QLQ-CR38 is a specific questionnaire module specifically designed for assessment of QoL in patients with colorectal cancer [21]. It consists of 38 items covering symptoms and side effects related to different colorectal cancer treatment modalities. The module contains four functional scales (body image, sexual functioning, sexual enjoyment, and future perspective) and eight symptom scales/items (micturition problems, chemotherapy side effects, gastrointestinal tract symptoms, male sexual problems, female sexual problems, defecation problems, stoma-related problems, and weight loss).

The questionnaires were scored according to the EORTC Scoring Manual [24]. Each item has four response alternatives (scoring 1–4), "not at all," "a little," "quite a bit," and "very much," except for the global QoL scale, which has seven alternatives (scoring 1–7) from "very poor" to "excellent." All questionnaire responses and scores were linearly transformed to a 0–100 scale. A higher score on the global QoL and functional scales represented a higher level of QoL and functioning, whereas a higher score on the symptom scales/items represented a higher degree of symptoms or dysfunction.

Mental health

Mental health was operationalized by anxiety and depression. The Hospital Anxiety and Depression Scale (HADS), comprising 14 items on a four-point Likert scale, was used to

assess symptoms of anxiety and depression. We used a score of 8 as a cutoff value for subthreshold depression and anxiety [25] and a cutoff of 11 for clinical depression and anxiety [26].

Statistical analyses

For baseline comparisons, patient characteristics in their continuous form were examined using the Student's *t* test, whereas discrete characteristics were examined using the Fisher exact test or Pearson, chi-square test. Differences between patients with and without a type D personality in sociodemographic and clinical characteristics were analyzed in a similar way. All continuous variables were presented as the means \pm SDs.

Univariate linear regression analyses were carried out to investigate the association of sociodemographic variables (age, gender, marital status, educational level, and medical insurance status) and clinical variables (stage, performance status, postoperative complications, anatomical location of tumor, and comorbidity) with the subscale and component scales of the QLQ-C30 and QLQ-CR38 questionnaires. We controlled for these variables in the analysis of covariance (ANCOVA), which was used to compare the means of QLQ-C30 and QLQ-CR38 scores between rectal cancer survivors with and without a type D personality. We used Norman's "rule of thumb" that the threshold of discrimination for changes in health status scores for a chronic disease appears to be approximately half a standard deviation [27]. For longitudinal assessment of changes of QoL scores over time, the Wilcoxon signed rank test was used to identify significant differences between QoL scores at the two different time points (at baseline and at 6 months after baseline). Statistical significance was defined as a *P* value less than 0.05. Analyses were performed using SPSS statistical software (SPSS version 19.0 for Windows; SPSS, Inc, Chicago, IL).

Results

Between July 2009 and July 2011, 908 Chinese patients with rectal cancer were enrolled in this prospective study. Fifty-six patients were excluded from the study. Twelve patients were excluded from analysis due to incomplete consent forms or missing identification. Four patients were excluded from analysis due to significant neurological deficits. Nine patients were excluded from analysis due to the longevous (age > 90). Thirty-one patients who had died prior to start of the second survey or had unverifiable addresses were excluded in order to eliminate the confounding factors and get more reliable results.

Table 1 Demographic data and clinical characteristics of the patients diagnosed as have rectal cancers by type of personality

	Type of personality		<i>P</i>
	Type D (<i>N</i> =187), <i>N</i> (%)	Non-type D (<i>N</i> =665), <i>N</i> (%)	
No of patients	187 (22)	665 (78)	NA
Age(year)			0.668
<50	24 (13)	73 (11)	
50-65	71 (38)	212 (32)	
65-80	66 (35)	253 (38)	
80-90	26 (14)	127 (19)	
Sex ratio male/female (%male)	90:97 (48)	352:313 (53)	0.245
Marital status			0.594
Married	150 (80)	545 (82)	
Not married	37 (20)	120 (18)	
Education			0.203
Less than high school	49 (26)	219 (33)	
High school	76 (41)	253 (38)	
College degree	62 (33)	193 (29)	
Socioeconomic group			<0.001*
Affluent	45 (24)	233 (35)	
Intermediate	71 (38)	292 (44)	
Deprived	71 (38)	140 (21)	
Medical insurance			<0.001*
Yes	110 (59)	512 (77)	
No	77 (41)	153 (23)	
No of patients undergoing potential curative surgery (%)	122 (65)	472 (71)	0.131
Colostomy			0.124
Yes	67 (36)	199 (30)	
No	120 (64)	466 (70)	
Comorbidities			<0.001*
0	32 (17)	200 (30)	
1	50 (27)	219 (33)	
2	64 (34)	146 (22)	
3 or more	41 (22)	100 (15)	
Performance status (ECOG)			0.070
0	66 (35)	292 (44)	
1	56 (30)	180 (27)	
2	43 (23)	146 (22)	
3 or 4	22 (12)	47 (7)	
Postoperative complications			0.445
Yes	18 (15)	57 (12)	
No	104 (85)	415 (88)	
Hospital stay (day)	13.4±8.3	12.7±6.1	0.572
Staging			0.441
I and II	95 (51)	359 (54)	
III and IV	92 (49)	306 (46)	
Anatomical location of tumor			0.659
Upper-mid rectum	108 (58)	372 (56)	
Low rectum	79 (42)	293 (44)	
Time from symptom onset to physician assessment			<0.001*
>1 month	123 (66)	279 (42)	

Table 1 (continued)

	Type of personality		<i>P</i>
	Type D (<i>N</i> =187), <i>N</i> (%)	Non-type D (<i>N</i> =665), <i>N</i> (%)	
<1 month	64 (34)	386 (58)	
Referral source			<0.001*
ED	43 (23)	67 (10)	
Non-ED	144 (77)	598 (90)	
Initial hemoglobin levels (mg/dL)	11.8±3.2	12.3±2.5	0.219
CEA (ng/mL)	107.4±416.5	93.6±383.7	0.670
CA19-9 (U/mL)	428.3±1827.4	405.2±1719.3	0.324
Cigarette smoking			0.611
No	88 (47)	299 (45)	
Yes	99 (53)	366 (55)	
Alcohol drinking			0.571
No	125 (67)	459 (69)	
Yes	62 (33)	206 (31)	

NA not applicable. TNM-primary tumor, regional lymph nodes, and distant metastasis

Based on Student's *t* test, Pearson χ^2 test, and Fisher exact test. * Statistically significant

Demographic and clinical characteristics

Twenty-two percent of rectal cancer patients in this study were classified as having a type D personality. Rectal cancer survivors with type D were more likely to report comorbid conditions at the time of questionnaire compared to rectal cancer survivors without type D ($P<0.001$). A significantly lower proportion of patients in affluent socioeconomic group were observed in the type D group (24 %) than those in non-type D group (35 %). Patients in the type D group had a significantly lower proportion of having medical insurance. The proportion of patients with duration of symptoms >1 month in type D group is significantly higher than that in non-type D group (66 vs 42 %, $P<0.001$). The proportion of patients being diagnosed after emergency admissions in type D group is significantly higher than that in non-type D group (23 vs 10 %, $P<0.001$) (Table 1).

Quality of life

EORTC QLQ-C30

At the baseline, the analysis of covariance revealed that type D patients reported statistically significant lower scores on role functioning, emotional functioning, cognitive function, social function, and global health status/QoL scales compared to patients without a type D personality after adjustment for confounding background variables (Table 2). Those with a type D personality reported a statistically significant and clinically relevant worse fatigue, constipation, and financial impact symptom scores compared with those without a type D personality

(Table 2). At 6 months, type D personality was associated with a poor cancer-related QoL among rectal cancer survivors (Table 2), as indicated by poor role, emotional, cognitive function and social functioning (all $P<0.001$), worse global health status ($P<0.001$), and more fatigue, insomnia, financial impact, and constipation symptoms (all P at least <0.001).

There was no significant decrease from baseline in physical, role, emotional, cognitive function, social functioning, and global QoL scores for the non-type D group at the 6-month time point. For the non-type D group, the constipation and loss of appetite symptom scores were worse than at baseline (Table 3). There was no significant change from baseline in physical and social function scores for the type D group at the 6-month time point. However, role, emotional, cognitive functioning, and global QoL scores were significantly worse than at baseline for the type D group. Furthermore, the fatigue, insomnia, financial impact, and constipation symptom scores were worse than at baseline for the type D group (Table 3).

Patients were classified as “improved” if at any time they reported a score that was >1/2 SD better than baseline. Those who did not improve were classified as having “worsened” if at any time they reported a score >1/2 SD points worse than baseline. Other patients were considered “stable.” All observed differences between two groups showed a percentage of patients with worsening QoL in the type D group compared with the non-type D group. Statistically significant differences between the two groups were observed for the role, emotional, cognitive function (all $P<0.01$), and global health status ($P<0.001$). At the 6-month time point, a higher percentage of patients in the type D group demonstrated QoL deterioration (Fig. 1a).

Table 2 Mean EORTC QLQ-C30 and EORTC QLQ-CR38 scores at baseline and 6 months from baseline, stratified by type D personality

	Mean (\pm SD) at baseline			Mean (\pm SD) at 6 months		
	Type D	Non-type D	<i>P</i> value	Type D	Non-type D	<i>P</i> value
EORTC QLQ-C30	(<i>n</i> =187)	(<i>n</i> =665)		(<i>n</i> =187)	(<i>n</i> =665)	
Physical functioning	80.2(18.6)	83.3(19.1)	0.459	78.4(19.5)	81.7(20.4)	0.538
Role functioning	67.1(27.9)	78.3(32.4)	<0.001* ^a	50.7(23.7)	76.5(27.9)	<0.001* ^a
Emotional functioning	65.2(26.6)	86.4(20.1)	<0.001* ^a	48.8(21.6)	87.3(25.7)	<0.001* ^a
Cognitive function	68.4(25.1)	83.7(28.3)	<0.001* ^a	51.6(22.4)	82.8(30.6)	<0.001* ^a
Social function	71.7(21.7)	79.9(19.8)	0.008*	65.7(20.9)	81.9(22.3)	<0.001* ^a
Global health status/QOL	63.8(19.7)	77.5(19.6)	<0.001* ^a	51.5(19.8)	76.9(21.7)	<0.001* ^a
Fatigue	44.3(28.6)	22.9(21.1)	<0.001* ^a	61.0(31.8)	25.7(22.1)	<0.001* ^a
Nausea and vomiting	4.1(9.4)	3.8(10.5)	0.568	4.8(10.3)	4.2(11.7)	0.673
Pain	16.3(24.9)	15.1(24.1)	0.271	17.4(23.1)	16.3(23.7)	0.461
Dyspnea	12.7(21.2)	12.1(22.1)	0.891	12.2(19.4)	11.8(20.8)	0.739
Insomnia	22.1(28.1)	17.4(25.9)	0.149	31.2(30.6)	18.9(27.1)	<0.001*
Loss of appetite	7.1(15.3)	7.6(16.3)	0.322	8.3(16.9)	12.6(18.4)	0.057
Constipation	12.9(24.1)	8.1(17.2)	0.005*	26.5(29.2)	11.8(18.1)	<0.001*
Diarrhea	8.5(18.8)	7.9(17.9)	0.661	9.0(19.1)	8.8(18.9)	0.859
Financial impact	19.4(29.4)	10.7(19.0)	<0.001*	24.1(27.9)	11.6(21.5)	<0.001*
EORTC QLQ-CR38						
Body image	84.5(23.0)	85.3(23.4)	0.786	81.4(28.5)	82.7(31.2)	0.692
Future perspective	66.2(19.7)	78.5(21.3)	<0.001* ^a	49.6(17.3)	77.1(19.9)	<0.001* ^a
Sexual function	22.4(21.9)	25.1(23.5)	0.263	11.0(18.8)	23.8(21.5)	<0.001* ^a
Sexual enjoyment	56.2(30.3)	59.6(31.5)	0.598	50.3(31.7)	55.6(26.1)	0.328
Micturition problems	31.7(16.3)	21.2(15.7)	<0.001* ^a	45.9(18.4)	24.5(16.4)	<0.001* ^a
Chemotherapy side effects	13.1(15.1)	11.5(13.2)	0.474	19.9(19.2)	16.2(15.7)	0.116
Gastrointestinal problems	16.7(14.6)	16.9(14.5)	0.931	18.6(17.1)	11.4(16.9)	0.001*
Male sexual problems	59.2(32.8)	55.4(31.6)	0.266	77.7(33.9)	56.8(30.7)	<0.001* ^a
Female sexual problems	28.3(27.6)	27.8(26.9)	0.881	32.5(34.2)	29.1(22.8)	0.453
Defecation problems	18.9(17.4)	16.5(16.3)	0.078	26.2(24.7)	18.4(17.0)	<0.001*
Stoma-related problems	22.5(19.0)	21.5(18.7)	0.678	25.1(20.6)	21.9(19.1)	0.532
Weight loss	5.1(14.8)	5.4(15.2)	0.724	6.0(15.3)	6.8(16.7)	0.323

A higher score on the EORTC QLQ-C30 and EORTC QLQ-CR38 functional scales and the EORTC QLQ-C30 global QOL scale means better functioning and QOL. A higher score on the EORTC QLQ-C30 and EORTC QLQ-CR38 symptom scales and the EORTC QLQ-CR38 single item on weight loss mean more complaints

Univariate linear regression analyses were carried out to investigate the association of sociodemographic variables (age, gender, marital status, educational level, and medical insurance status) and clinical variables (stage, performance status, postoperative complications, anatomical location of tumor, and comorbidity) with the subscale and component scales of the QLQ-C30 and QLQ-CR38 questionnaires. We controlled for these variables in the analysis of covariance (ANCOVA). *Statistically significant

^a Clinically relevant differences were determined according to the Nonman's rule of thumb

EORTC QLQ-CR38

At the baseline, the analysis of covariance revealed that type D patients reported statistically significant and clinically relevant lower scores on future perspective compared to patients without a type D personality after adjustment for confounding background variables (Table 2). Those with a type D personality reported a statistically significant and clinically relevant worse micturition problem scores compared with those without a type D personality (Table 2).

At 6 months, type D personality was associated with a poor cancer-related QoL among rectal cancer survivors (Table 2), as indicated by future perspective and sexual function (both $P < 0.0001$), and more micturition problems, gastrointestinal problems, male sexual problems, and defecation problems (all P at least < 0.001).

There was no significant decrease from baseline in body image, future perspective, sexual function, and sexual enjoyment scores for the non-type D group at the 6-month time point. For the non-Type D group, only the chemotherapy side effect

Table 3 Longitudinal assessment of changes in European Organization for Research and Treatment of Cancer QLQ-C30 and QLQ-CR38 scores of the type D and non-type D gastric cancer patients

	Mean (\pm SD) of the non-type D patients			Mean (\pm SD) of the type D patients		
	Baseline (<i>n</i> =665)	6 months (<i>n</i> =665)	<i>P</i> value	Baseline (<i>n</i> =187)	6 months (<i>n</i> =187)	<i>P</i> value
EORTC QLQ-C30						
Physical functioning	83.3(19.1)	81.7(20.4)	0.347	80.2(18.6)	78.4(19.5)	0.692
Role functioning	78.3(32.4)	76.5(27.9)	0.386	67.1(27.9)	50.7(23.7)	<0.001* ^a
Emotional functioning	86.4(20.1)	87.3(25.7)	0.765	65.2(26.6)	48.8(21.6)	<0.001* ^a
Cognitive function	83.7(28.3)	82.8(30.6)	0.812	68.4(25.1)	51.6(22.4)	<0.001* ^a
Social function	79.9(19.8)	81.9(22.3)	0.831	71.7(21.7)	65.7(20.9)	0.183
Global health status/QOL	77.5(19.6)	76.9(21.7)	0.856	63.8(19.7)	51.5(19.8)	<0.001* ^a
Fatigue	22.9(21.1)	25.7(22.1)	0.094	44.3(28.6)	61.0(31.8)	<0.001* ^a
Nausea and vomiting	3.8(10.5)	4.2(11.7)	0.542	4.1(9.4)	4.8(10.3)	0.453
Pain	15.1(24.1)	16.3(23.7)	0.478	16.3(24.9)	17.4(23.1)	0.511
Dyspnea	12.1(22.1)	11.8(20.8)	0.769	12.7(21.2)	12.2(19.4)	0.635
Insomnia	17.4(25.9)	18.9(27.1)	0.299	22.1(28.1)	31.2(30.6)	0.001*
Loss of appetite	7.6(16.3)	12.6(18.4)	<0.001*	7.1(15.3)	8.3(16.9)	0.097
Constipation	8.1(17.2)	11.8(18.1)	0.017*	12.9(24.1)	26.5(29.2)	<0.001* ^a
Diarrhea	7.9(17.9)	8.8(18.9)	0.176	8.5(18.8)	9.0(19.1)	0.358
Financial impact	10.7(19.0)	11.6(21.5)	0.319	19.4(29.4)	24.1(27.9)	0.024*
EORTC QLQ-CR38						
Body image	85.3(23.4)	82.7(31.2)	0.462	84.5(23.0)	81.4(28.5)	0.469
Future perspective	78.5(21.3)	77.1(19.9)	0.571	66.2(19.7)	49.6(17.3)	<0.001* ^a
Sexual function	25.1(23.5)	23.8(21.5)	0.433	22.4(21.9)	11.0(18.8)	<0.001* ^a
Sexual enjoyment	59.6(31.5)	55.6(26.1)	0.286	56.2(30.3)	50.3(31.7)	0.081
Micturition problems	21.2(15.7)	24.5(16.4)	0.087	31.7(16.3)	45.9(18.4)	<0.001* ^a
Chemotherapy side effects	11.5(13.2)	16.2(15.7)	0.001*	13.1(15.1)	19.9(19.2)	<0.001*
Gastrointestinal problems	16.9(14.5)	11.4(16.9)	0.003*	16.7(14.6)	18.6(17.1)	0.264
Male sexual problems	55.4(31.6)	56.8(30.7)	0.546	59.2(32.8)	77.7(33.9)	<0.001* ^a
Female sexual problems	27.8(26.9)	29.1(22.8)	0.461	28.3(27.6)	32.5(34.2)	0.318
Defecation problems	16.5(16.3)	18.4(17.0)	0.318	18.9(17.4)	26.2(24.7)	0.016*
Stoma-related problems	21.5(18.7)	21.9(19.1)	0.875	22.5(19.0)	25.1(20.6)	0.157
Weight loss	5.4(15.2)	6.8(16.7)	0.177	5.1(14.8)	6.0(15.3)	0.169

A higher score on the EORTC QLQ-C30 and EORTC QLQ-CR38 functional scales and the EORTC QLQ-C30 global QOL scale means better functioning and QOL. A higher score on the EORTC QLQ-C30 and EORTC QLQ-CR38 symptom scales and the EORTC QLQ-CR38 single item on weight loss mean more complaints.

Based on Wilcoxon signed rank test. *Statistically significant

^a Clinically relevant differences were determined according to the Norman's rule of thumb

scores were worse than at baseline, the gastrointestinal problem scores were better than at baseline (Table 3). At the 6-month time point, future perspective and sexual function scores were significantly worse than at baseline for the type D group. Furthermore, the micturition problems, chemotherapy side effects, defecation problems, and male sexual problems scores were worse than at baseline for the type D group (Table 3).

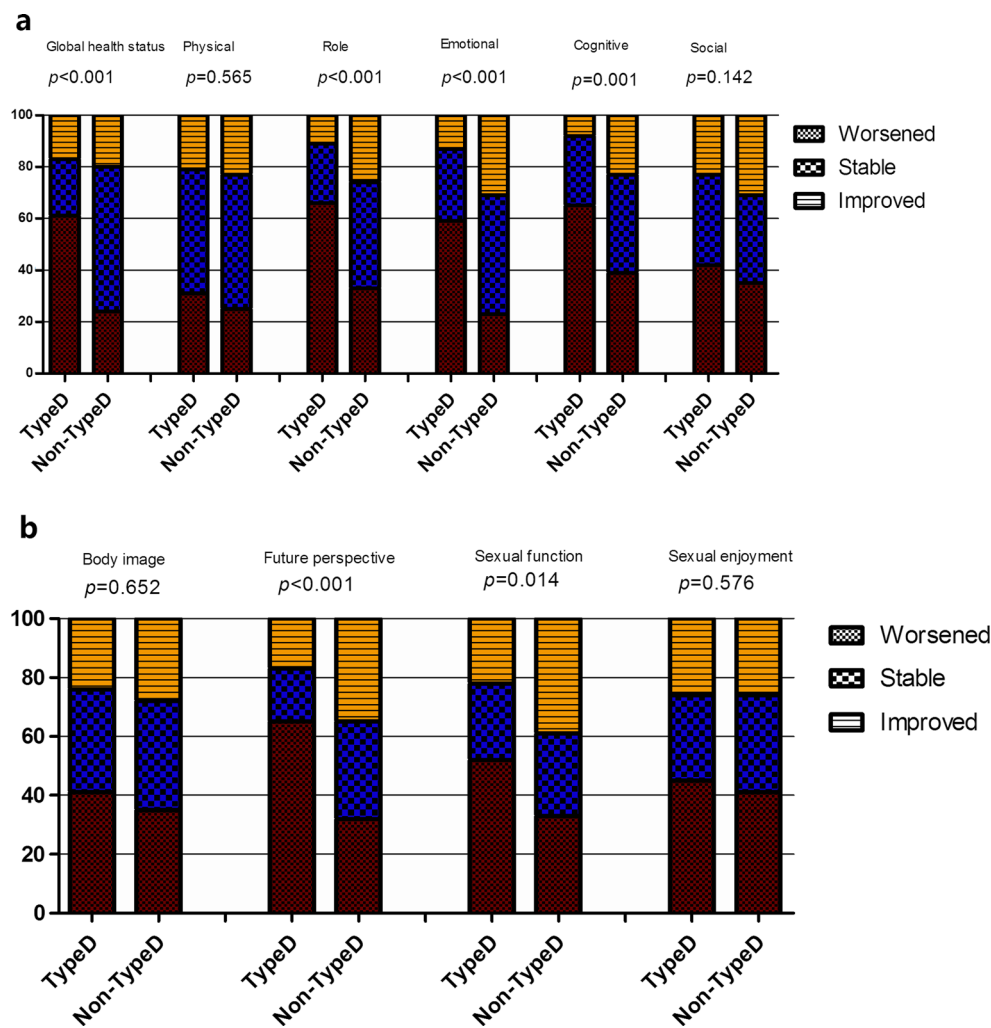
All observed differences between two groups showed a percentage of patients with worsening QoL in the type D group compared with the non-type D group. Statistically

significant differences between the two groups were observed for the future perspective and sexual function scales (both $P < 0.05$). At the 6-month time point, a higher percentage of patients in the type D group demonstrated QoL deterioration (Fig. 1b).

Mental health

Cancer survivors with a type D personality had higher levels of anxiety and depression compared to non-type D survivors.

Fig. 1 Quality of life (QoL) response assessment is shown among the percentages of patients with improved, stable, and worsened QoL over time by personality group with regard to scales of EORTC QLQ-C30 and EORTC QLQ-CR38. **a** Quality of life (QoL) response assessment is shown among the percentages of patients with improved, stable, and worsened QoL over time by personality group with regard to function domains and global QoL scales of EORTC QLQ-C30. **b** Quality of life (QoL) response assessment is shown among the percentages of patients with improved, stable, and worsened QoL over time by personality group with regard to function domain scales of EORTC QLQ-CR38



Clinically elevated levels of anxiety and depression, which was defined as a cutoff value of ≥ 11 on the HADS [26], were more prevalent in type D than in non-type D survivors at the baseline and 6-month time point (both $P < 0.001$) (Fig. 2).

Discussion

Our study comprised 852 RC patients, 187 (22 %) patients comprised the type D personality group; another 665 (78 %) patients comprised the non-type D group. Twenty-two percent of rectal cancer patients in this study were classified as having a type D personality. This is within the range of type D prevalence in the normal population, which ranges from 13 to 24 % [8].

Type D patients reported a statistically significant and clinically relevant lower health status measured by the EORTC QLQ-C30 and EORTC QLQ-CR38. This finding confirms previous results found in a study among 562 melanoma survivors that also reported that type D personality had a distinct negative impact on health status as measured by the SF-36

[13]. Type D personality has also been associated with an impaired QoL among a variety of other populations such as patient with cardiovascular disease, chronic tinnitus [28], and general population [29], suggesting that type D personality is a general vulnerability factor that adversely affects QoL across populations and conditions.

Type D patients had a clinically relevant worse cognitive function, social function, emotional function, role function, future perspective, and global health status/QoL, even after controlling for important variables that are known to have an influence such as tumor stage and comorbidity. How people deal with cancer and how they perceive the situation can have a major impact on their health status, regardless of the type of cancer. The improvement of the overall QoL not only depends on the treatment level but is also affected by patients' attitudes and opinions toward their diseases [30]. With a non-type D personality, patients do not easily fall victim to negative emotions, which is more indicative of a healthy psychological status. Non-type D personality implies a positive change in cognition and emotion, which can weaken a patient's negative self-evaluation. Proactive coping promotes physical recovery,

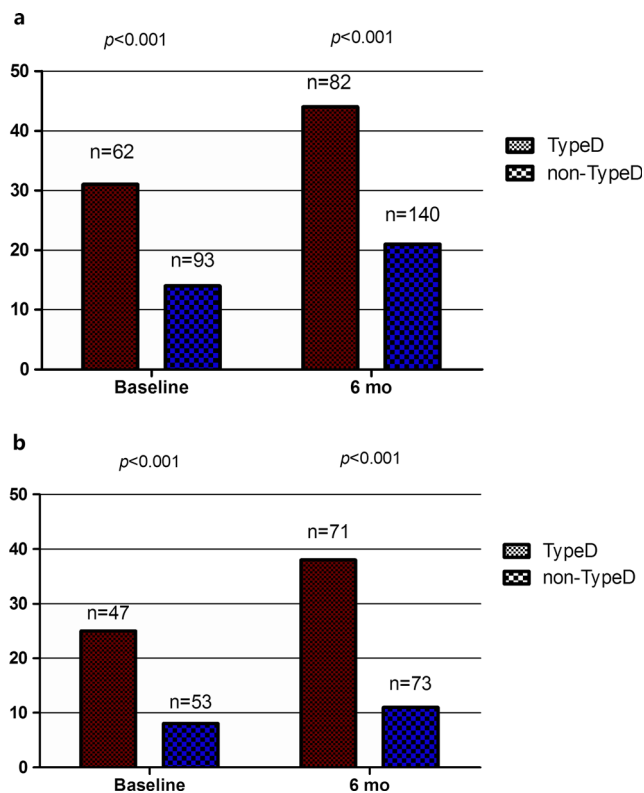


Fig. 2 Percentage of rectal cancer patients with anxiety and depression, stratified by type D personality. **a** Percentage of rectal cancer patients with anxiety, stratified by type D personality. **b** Percentage of rectal cancer patients with depression, stratified by type D personality. Figure legend: a HADS score of 11 was used as a cutoff value for clinical depression

improving the patient's body and functional status. With non-type D personality, patients show better cognitive function, social function, emotional function, role functioning, body image, and higher confidence in future health.

We found that rectal cancer patients in the type D personality group experienced increased levels of anxiety compared to non-type D patients, which is in accordance with the literature in cardiovascular [31, 32]. Type D survivors were also more often depressed compared to non-type D survivors. Type D personality thus seems to be a stable predictor of depressive and anxiety symptoms among rectal cancer survivors.

On longitudinal assessment, our results showed that the QoL scores of most of the functional and symptom scales in the non-type D group remained relatively stable at different time points, whereas most of the QoL scores in the type D group predominantly showed deterioration at 6 months after diagnosis. A greater deterioration of QoL on type D patients can possibly be explained by the fact that negative affectivity is one of the main characteristics of type D, which implies that these patients have the tendency to experience negative emotions in general. We found that cognitive function, emotional function, future perspective, and global health status/QoL were significantly negatively correlated with type D personality. Patients' emotional function and future perspective play an

important role in the determination of QoL. According to the dynamic model proposed by Carr et al. [33], future perspective is typically impacted when the health experience falls short of expectations. Discrepancies between expectations and the experience may explain the deterioration of QoL in the type D group. Because of the negative affectivity, patients in the type D group might estimate their chances of disease progression somewhat higher than non-type D patients; so, the type D patients have worse future perspective than patients in the non-type D group, a significant impact on QoL occurred. A period of adaptation and alteration of expectations may have been needed to reestablish "expectation-experience homeostasis" by over 6 months after diagnosis.

In our study, Sexual function was reported to be equal to baseline after 6 months in non-type D patients. However, some recent papers have shown that approximately 25 % sexual impairment is to be expected after rectal cancer treatment [34]. There are several reasons for this phenomenon. First, In China, the emotional expression is relatively restrained and subtle. People do not want to talk openly about or discuss the sexual difficulty question. The difficulties in capturing responses to questions on sexual function may explain the wide variation in results from previous studies. Second, the follow-up of our study was much shorter than some recent papers. Sexual function scores in the rectal cancer patients predominantly showed deterioration at 12–36 months after diagnosis [34]. Chemotherapy and radiotherapy after operation could increase the opportunity to have difficulties with sexual matters gradually. The time interval of our study is 6 months, the worsening of sexual function scores over time might not reach the statistical significant degree.

Another reason for a greater deterioration of QoL on type D patients could be the longer symptom duration and higher proportion of being diagnosed after emergency admissions. In our study, a relationship between the duration of symptoms, referral sources, and personalities of RC has been suggested. We observed that Chinese patients in type D group had a higher proportion of symptom duration >1 month and being diagnosed after emergency admissions. Diagnosis of the disease during the asymptomatic or preclinical period might improve the prognosis and QoL of RC [18]. The results of our study highlight the fact that patient personalities contribute to the delay in diagnosis and influence the referral sources and the preservation of QoL in Chinese patients with RC. Negative affectivity and social inhibition are the two main characteristics of type D personality. People that score high on social inhibition have the tendency not to express these emotions. The emotional expression of type D patients is relatively restrained and subtle. People with a type D personality do not want to talk openly about or discuss unlucky events, such as disease and cancer [35]. Therefore, the number of visits to a medical specialist of type D patients is less than the non-type D patients, and the symptom duration of type D patients is

relatively longer than the non-type D ones. Type D patients were the most symptomatic and had the most impaired QoL, which might be, at least partly, explained by the longer symptom duration and higher proportion of emergency admissions. Therefore, we conclude that type D personality is a predictor of a higher proportion of symptom duration >1 month and being diagnosed after emergency admissions. It is also one of the reasons for a greater deterioration of QoL on type D rectal cancer patients.

The present study has limitations that should be mentioned. Our study is a single center, prospective longitudinal study; the sample size is finite. During the process of surveys, 56 patients were excluded from the study. We had, unfortunately, no access to patient files of the nonrespondents and thus were unable to analyze reasons for their lack of response. Patients with advanced CRC who are undergoing chemotherapy experience significant fatigue and other symptoms that may lead to reluctance to complete QoL assessments as time goes on. It is possible, perhaps even probable, that their disease was at a more advanced stage; so, it is possible that most of excluded patients had advanced tumor diseases. The emotional expression of type D patients is relatively restrained and subtle. People with a type D personality do not want to talk openly about or discuss unlucky events, such as disease and cancer. Therefore, the compliance rate of type D patients may be lower than the non-type D patients during the process of surveys. So, we infer that a large number of type D patients with advanced tumor diseases were excluded from the study, such that the proportion of advanced tumor disease of type D personality group presented here might be an underestimation.

Our study has several strengths. First, although non-randomized, the baseline characteristics and socio-demographic data of the two groups of patients were similar, and a fair comparison could therefore be made. Another strength of our study, as compared with many previous survivorship studies, is the high response rate that facilitates generalizing the results to the larger population of rectal cancer survivors. In addition, we evaluated a broad spectrum of possible confounding factors. Our study provided insight into the role of type D personality on health status, symptom duration, and impact of referral sources among rectal cancer survivors 6 months after diagnosis. These results call for further research on type D personality among rectal cancer survivors followed over a longer period of time.

In conclusion, type D personality was associated with poor QoL and mental health status among survivors of rectal cancer, even after adjustment for confounding background variables. Type D personality might be a general vulnerability factor to screen for subgroups at risk for longer symptom duration and emergency admissions in clinical practice. Giving special attention to those patients is important while they are more likely to experience a strong negative impact of cancer on their QoL than the non-type D patients which

cannot be explained by sociodemographical or clinical characteristics.

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Conflict of interest The authors declare that they have no competing interests.

Authors' contributions ZHANG Jia-kui: study concepts, study design, data acquisition and interpretation, manuscript preparation and editing. FANG Li-li: study design and manuscript preparation. ZHANG De-wei: study design and manuscript preparation. JIN Qiu: study design, manuscript preparation and editing. WU Xiao-mei followed up the patients, collected the data, analyzed the data. LIU Ji-chao: followed up the patients, collected the data. ZHANG Chun-dong: data acquisition, manuscript review. DAI Dong-qiu: study concepts, study design, manuscript preparation and editing, manuscript review. All authors have seen the manuscript and approved to submit to your journal.

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